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The Influence of Laundering and Exposure to Light upon Some Wash Silks Used for Outer Garments

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THE INFLUENCE OF LAUNDERING AND EXPOSURE TO LIGHT UPON SOME WASH SILKS USED FOR OUTER GARMENTS

MARION E. GRIFFITH

INTRODUCTION

Washable silks used for outer garments may be divided, according to the fiber used, into three classes: 1, pure dye mulberry or cultivated silk; 2, weighted mulberry silk; and 3, pure dye wild silk.

Pure dye silks may contain from 15 to 25 per cent weighting materials, or an amount equivalent to the weight lost by the silk in the degumming process. The Silk Association of America, in a report (8) on a method for determining silk weighting, defines weighting as follows: "By weighting is meant not only metallic weighting, but all materials other than fibroin present in the finished silk after it has been dried to constant weight in air at 110° C". Scott (7) says that, if the weighting of the silk is carefully done and kept within reasonable limits, the strength and the lasting qualities of the fibers are unimpaired and that new and desirable qualities are imparted to the silk. He recognizes, however, that faulty manipulation and overloading cause injury to the fiber. Grove-Palmer (3) gives 55 per cent as the maximum percentage weighting which is safe for crepes de Chine; whereas Harris (4) says that 15 to 20 per cent is the maximum safe weighting if the weighting is not to interfere with the wearing qualities and washability of the fabric.

The suitability of a silk fabric for use in a washable silk garment may be judged by a study of the effect of washing upon the size, strength, and color of the garment. Since washable silks are more widely used during the summer months, it is also desirable to know how the sunlight affects the strength and color of these fabrics.

For the work reported herein, three types of washable silk fabrics were analyzed in an attempt to determine the relative color fastness and strength of these types after laundering and exposure to light.

EXPERIMENTAL PROCEDURE

FABRICS STUDIED

Fifteen silks, ranging in price from $1.00 to $3.98 per linear yard, were purchased after a study had been made of the types of washable silks found in representative Ohio stores. Silks designated as A, B, C, D, E, F, and G were pure dye; H, I, J, K, L, and O were weighted; and M and N were of wild silk. A and O were produced by the same manufacturer. A was pure dye and O was weighted. D and G were both pure dye silk and were produced by the same manufacturer. A, B, and O had the name of the manufacturer woven in the selvage. C, E, and F were not marked but were guaranteed by the stores to be pure dye and washable. D and G had the manufacturer's name stamped on the selvage. M was distinguished by a particular type of selvage, and N had no marking. With the exception of O, none of the weighted silks had any marking. For the physical and chemical analyses and endurance tests, white silks were purchased. To determine fading, swatches in six colors in each type of silk were purchased. The colors were pink, peach, yellow, green, blue, and violet. An effort was made to secure similar colors in each of the silks, but this was not possible in all cases.

PHYSICAL ANALYSIS

The physical analysis included the following determinations: width, thread count, yarn count, yarn diameter, thickness, weight, filament count, breaking strength, bursting strength, and shrinkage.

Width.—The width was determined by laying the fabric on a flat surface without tension and then measuring, with an accuracy of one-sixteenth of an inch, the distance perpendicularly from edge to edge. Five measurements were taken at different places in the sample and the results averaged (9).

Thread count.—The actual number of threads in one inch of width were counted in each direction at five different places in the fabric and the results averaged for each direction (9). The Lowinson thread counter was used for this determination.

Yarn count.—The average bone-dry weight of two 10-yard lengths in both warp and filling directions was used for this test. The yarn count was expressed in number of yards of yarn per pound.

Yarn diameter.—The diameter of the yarn varies approximately as the reciprocal of the square root of its number of yards per pound.

Thickness.—The average thickness, in inches, of the fabric was determined from 10 measurements taken at different parts of the fabric (exclusive of fabric within 6 inches of the selvage) by means of a micrometer caliper which exerted constant pressure on a circle of fabric $\frac{3}{8}$ inch in diameter.

Weight.—Three samples, measuring 3 inches in length and the entire width of the new fabric from selvage to selvage, were heated to constant weight at 100° C. The average of these bone-dry weights was used as a basis for calculating the weight per square yard (9).

Filament count.—The number of filaments in five different yarns was counted and the results averaged.

Breaking strength.—The breaking strength was determined according to the 1 x 1 x 3 inch grab method (9). The Scott Universal tester was used. For the dry breaking strength, the samples were heated bone dry in an electric oven at 100° C., cooled in a dessicator, and tested. For the wet breaking strength, the samples were soaked in distilled water for 5 minutes, drained, and tested. The breaking strength, wet and dry, was determined for new and laundered samples and for samples after exposure to light. Five samples in each direction were tested and the results averaged. The strength-weight factor was recorded for the new fabric as follows:

$$\text{Strength-weight factor} = \frac{\text{Warp breaking strength} + \text{filling breaking strength}}{\text{Fabric weight, in ounces per square yard}}$$

Bursting strength.—The bursting strength was determined by means of a ball burst test attachment to the Scott Universal tester. New and laundered fabrics and fabrics exposed to the light were tested. Five wet samples and five bone-dry samples were tested and the results averaged.

Shrinkage.—Two samples, 6 inches filling by 8 inches warp, were used to test shrinkage. Yarns were drawn one inch from edges to form a rectangle 4 inches by 6 inches. These fabrics were soaked in boiling distilled water for 30 minutes and were then removed and soaked in distilled water at room temperature for 30 minutes. When almost dry they were ironed, measured again, and the percentage shrinkage calculated.

CHEMICAL ANALYSIS

The chemical analysis included the following determinations: percentage moisture, quantitative water extract, qualitative water extract, quantitative ether extract, percentage weighting, percentage nitrogen, and percentage fibroin.

Test for protein.—Millon's reagent was used.

Percentage moisture.—For the moisture determination two samples of air-dry fabric of approximately 2 grams were weighed. They were then dried to constant weight at 100° C. The loss in weight was calculated as per cent of moisture.

Quantitative water extract.—Two bone-dry samples of approximately 5 grams were boiled for one hour in 500 cc. of distilled water. They were then dried to constant weight and the loss in weight calculated (on the basis of the bone-dry samples) as the per cent of water soluble materials.

Qualitative water extract.—The water extract from the above samples was concentrated, and qualitative tests were made for the presence of dextrin and gums, starch, sucrose, reducing sugars, gelatin, chlorides, sulfates, calcium, magnesium, and zinc.

Quantitative ether extract.—Two bone-dry samples of approximately 5 grams each were extracted with ether for 16 hours in a Sohxlet extractor and again dried to constant weight. The loss in weight was calculated (on the basis of the bone-dry sample) as the per cent of ether extract.

Percentage weighting.—All materials other than fibroin present in the finished silk, after it had been dried to constant weight in air at 100° C., were designated as weighting. Two samples measuring 3 inches in length and the entire width of the original fabric were taken from each swatch for analysis. They were first tested for the presence of silicates. The procedure for this test and for the determination of weighting was that recommended by the Technical Committee of the Silk Association as the Standard Method (8) and was as follows:

I. *Test for Silicate.*

A small sample was ignited, the ash placed in a platinum crucible, and two drops of concentrated hydrofluoric acid added. If silicate was present, chemical action accompanied by a considerable amount of heat was noticed.

II. *Procedure for Determining Tin Phosphate Silicate Weighting.*

A. The sample was dried to constant weight in an air oven at 100° C. This is Weight A.

B. The dried sample was soaked in 100 times its weight of distilled water at 65° C. for 20 minutes; it was moved about in the water every few minutes during this time in order to insure thorough penetration of water and extraction of water-soluble materials. The sample was then rinsed in a fresh portion of distilled water, then in alcohol, and finally in ether, after which the sample was dried to constant weight, as above. (Two 25 cc. portions of alcohol and of ether are usually sufficient). This is Weight B.

$$\frac{\text{Weight A}-\text{Weight B}}{\text{Weight A}} \times 100 = \text{Percentage finishing materials}$$

C. The sample from which "finishing material" had been removed was soaked in 100 times its weight of 2 per cent hydrofluoric acid solution at 65° C. for 20 minutes. The sample was then rinsed in water, in alcohol, and in ether and dried to constant weight as before. This is Weight C.

D. The sample was then ashed and the ash weighed. This is Weight D. This ash should not weigh more than one-tenth of the difference between Weight B and Weight C.

E.

$$\frac{\text{Weight A}-\text{Weight C}+\text{Weight D}}{\text{Weight A}} \times 100 = \text{Percentage weighting}$$

III. *Procedure for Determining Tin Phosphate Weighting.*

The procedure for determining tin phosphate weighting in silk which does not contain silicate is the same as that given in II above, except that the sample from which finishing material had been removed was soaked in 100 times its weight of 40 per cent hydrochloric acid solution at 55° C. for 20 minutes. This was repeated with a fresh solution. The sample was then rinsed in water and soaked in 100 times its weight of 10 per cent sodium carbonate solution at 55° C. for 20 minutes. The sample was then rinsed in water and the hydrochloric acid treatment repeated. The sample was again rinsed in water, then in alcohol, and in ether and dried to constant weight as before. This was called Weight C.

Percentage nitrogen.—Kjeldahl nitrogen was determined on fabrics which had been boiled in water to remove any water-soluble finishing materials which might contain nitrogen.

Percentage fibroin.—The per cent of Kjeldahl nitrogen multiplied by 5.147 gave the per cent of fibroin (6).

LAUNDERING

The method of washing was the same for both the white and colored silks. Samples of the colored silks being used for determination of fading were cut 2½ inches by 4 inches. Those samples of white silks which were to be used for testing the bursting strength were cut 4 inches by 4 inches; whereas the samples to be used in testing breaking strength were 4 inches by 6 inches. One sample of colored fabric, or one breaking strength sample, or two bursting strength samples were placed in each jar in the Launder-ometer (2). The samples were washed in the Launder-ometer for 30 minutes in 100 cc. of a 10 per cent solution of a neutral soap in distilled water. They were then removed and rinsed in 200 cc. of clear distilled water for 10 minutes. The temperature of the jars and that of the water in the Launder-ometer surrounding the jars was kept at 41° C. The samples were removed and dried before a fan. One set of samples of the white fabrics used for breaking and bursting strength determinations was laundered once and another set fifteen times. Four sets of samples of the colored fabrics were laundered, respectively, once, and five, ten, and fifteen times.

EXPOSURE TO LIGHT

White and colored silks were exposed to the light of the Fade-ometer (1) for periods of 6, 12, 24, and 48 hours. The white silks were fastened to the inside of the drum by means of gummed paper. The colored silks were treated in the usual manner.

COLOR ANALYSIS

The new colored fabrics and those which had been exposed to the light and laundered were matched with the colors given in the *Dictionary of Color* by Maerz and Paul (5).

RESULTS

The results of the physical analysis of the new white silks are given in Table 1. The price of the pure dye silks ranged from $1.78 to $3.68 per square yard, with an average price of $2.42. The weighted silks cost from $1.49 to $2.72, with an average price of $1.92 per square yard. The prices of the two wild silks (M and N) were $1.12 and $1.14, respectively.

TABLE 1.—Physical Analysis of New Silks

	Mulberry silks							
	Pure dye silks							Average pure dye silks
	A	B	C	D	E	F	G	
1. Construction	Plain weave crepe	Plain weave crepe	Plain weave crepe	Plain weave crepe	Plain weave crepe	Plain weave crepe	Plain weave crepe	....
2. Width, in inches	39.2	40.4	39.7	39.3	38.7	38.5	38.9	39.3
3. Weight, in ounces per square yard	1.89	1.89	1.84	1.85	1.85	1.90	2.44	1.95
4. Price, per square yard	$1.84	$1.78	$2.72	$2.29	$2.32	$2.34	$3.68	$2.42
5. Thickness, in inches	0.00578	0.00581	0.00508	0.00487	0.00634	0.00587	0.00651	0.0058
6. Yarns, per inch:								
Warp	133	189	130	133	198	143	201	161
Filling	78	86	95	94	90	91	102	91
7. Yarn count, in yards per pound:								
Warp	70,062	108,873	70,062	104,368	126,111	79,232	76,689	90,777
Filling	60,940	53,224	68,788	72,063	74,062	66,667	62,277	65,432
8. Yarn diameter, in inches:								
Warp	0.0037	0.0030	0.0037	0.0030	0.0028	0.0035	0.0036	0.0033
Filling	0.0040	0.0043	0.0038	0.0037	0.0036	0.0038	0.0040	0.0039
9. Number of filaments:								
Warp	48	27	51	37	34	44	38	40
Filling	47	29	29	41	43	42	48	40
10. Wet breaking strength, in pounds:								
Warp	112	97	140	102	114	114	135	116
Filling	60	79	77	77	75	68	72	73
11. Dry breaking strength, in pounds:								
Warp	154	126	161	135	135	135	151	142
Filling	85	99	95	74	83	74	79	84
12. Bursting strength, in pounds:								
a. Wet	129	127	136	133	116	120	158	131
b. Dry	150	146	157	160	132	142	210	157
13. Strength-weight factor:								
a. Wet	91.00	93.12	117.93	96.75	102.16	95.78	84.83	97.37
b. Dry	126.45	119.04	139.13	112.97	117.83	110.00	94.26	116.28

TABLE 1.—Physical Analysis of New Silks—Continued

	Mulberry silks							Wild silks		
	Weighted silks						Average weighted silks			Average wild silks
	H	I	J	K	L	O		M	N	
1. Construction	Plain weave crepe	Plain weave crepe	Plain weave crepe	Plain weave crepe	Plain weave crepe	Plain weave crepe	.....	Plain weave	Plain weave	.....
2. Width, in inches	39.0	38.6	38.3	38.6	38.3	38.9	38.6	32.0	31.6	31.8
3. Weight, in ounces per square yard	3.18	2.40	2.39	2.25	2.47	3.55	2.70	1.62	1.93	1.77
4. Price, per square yard	$2.72	$1.84	$1.49	$1.82	$1.57	$2.08	$1.92	$1.12	$1.14	$1.13
5. Thickness, in inches	0.00725	0.00561	0.00576	0.00556	0.00581	0.00720	0.0062	0.00530	0.00526	0.00530
6. Yarns, per inch:										
Warp	141	185	165	180	171	133	162	65	85	75
Filling	83	84	72	78	69	69	76	80	80	80
7. Yarn count, in yards per pound:										
Warp	38,345	61,853	58,961	64,489	59,934	35,636	53,203	33,605	57,687	45,646
Filling	50,557	64,397	63,585	58,922	56,785	31,096	54,223	112,515	65,749	89,132
8. Yarn diameter, in inches:										
Warp	0.0051	0.0040	0.0041	0.0039	0.0040	0.0052	0.0043	0.0054	0.0041	0.0045
Filling	0.0044	0.0039	0.0039	0.0041	0.0042	0.0056	0.0043	0.0029	0.0039	0.0034
9. Number of filaments:										
Warp	47	35	37	29	35	44	38	57	28	32
Filling	39	37	40	31	36	57	40	131	90	110
10. Wet breaking strength, in pounds:										
Warp	102	107	90	85	101	114	100	75	37	56
Filling	61	54	50	54	46	85	68	54	88	71
11. Dry breaking strength, in pounds:										
Warp	50	92	47	86	55	106	73	70	47	58
Filling	24	29	20	24	11	69	30	96	121	108
12. Bursting strength, in pounds:										
a. Wet	118	101	90	95	95	148	108	180	99	139
b. Dry	59	46	34	49	30	91	51	118	90	104
13. Strength-weight factor:										
a. Wet	51.25	67.08	58.57	61.77	59.51	56.05	59.04	79.62	64.76	72.19
b. Dry	23.27	50.41	28.03	48.88	26.72	49.29	37.76	102.46	87.04	94.70

Weight and thickness were found to be greatest in the weighted silks and lowest in the wild silks.

The yarn count and yarn diameter were better balanced for warp and filling directions with the weighted silks than with either the pure dye or wild silks.

The wild silks showed the best balance in thread count, although the number of filaments in the filling and warp yarns was very poorly balanced.

The weighted and pure dye silks were quite similar in thread count and number of filaments.

The dry breaking strength, warp and filling, and the dry bursting strength of the pure dye silks were greater than the wet breaking strength. The wild silks had a higher breaking strength but lower bursting strength when wet than when dry. The weighted silks showed much higher strength when wet than when dry, but even the wet strength of these silks was not as high as the wet strength of the pure dye silk.

As indicated in Table 2, the average percentage ash from the weighted silks, 52 per cent, was approximately four times that of the pure dye silks, 14 per cent, and three times that of the wild silks, 18 per cent. Less difference was noted in water extract and percentage finishing materials, but here again the weighted silks showed the highest percentage.

Silks designated as H, I, J, K, L, and O gave a test for silicate.

An analysis of Table 3 shows that all three types of silk contain water-soluble finishing materials. The weighted silks contain more than the pure dye silks. Sugars, chlorides, and sulfates were found in all three types of silks, but no silk gave a test for starch, magnesium, or zinc. Dextrin and gums and calcium were found only in the weighted and wild silks. C and G, the most expensive of the pure dye silks, contained the least finishing materials, and L and I, both very heavily weighted, were highest in water-soluble finishing materials.

Table 4 shows the thickness of the silks before and after laundering. The weighted silks had greater original thickness and greater increase in thickness after laundering than the pure dye silks. The wild silks, M and N, had the least thickness when new but showed the greatest increase in thickness due to laundering.

TABLE 2.—Chemical Analysis of New Silks

Percentage	Mulberry silks							
	Pure dye silks							Average pure dye silks
	A	B	C	D	E	F	G	
Ash	11	20	9	15	11	13	18	14
Finishing materials	5	13	4	9	6	8	6	7
Water extract	5	10	2	8	8	7	4	6
Ether extract	3	5	1	2	1	2	3	2
Kjeldahl nitrogen	17.2	15.9	12.0	16.7	16.4	16.6	15.7	15.7
Fibroin	93	85	65	91	89	90	85	85
Moisture	3.7	3.6	3.4	3.5	3.7	3.4	5.8	3.9

TABLE 2.—Chemical Analysis of New Silks—Continued

Percentage	Mulberry silks							Wild silks		
	Weighted silks						Average weighted silks	M	N	Average wild silks
	H	I	J	K	L	O				
Ash	50	53	54	51	55	50	52	17	19	18
Finishing materials	3	5	5	6	6	6	5	10	2	6
Water extract	6	9	10	10	10	9	9	9	3	6
Ether extract	0	1	1	2	1	3	1	3	0	1.5
Kjeldahl nitrogen	6.6	0.2	7.1	8.3	7.2	8.8	6.3	15.9	17	16.5
Fibroin	36	1	39	45	39	48	35	86	92	89
Moisture	7.7	7.5	7.3	7.5	7.8	6.1	7.3	5.6	5.8	5.7

TABLE 3.—Water-soluble Finishing Materials

Test for presence of:	A	B	C	D	E	F	G	H	I	J	K	L	O	M	N
1. Starch	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
2. Dextrin and gums	−	−	−	−	−	−	−	−	+	−	−	+	+	+	−
3. Sugars:															
a. Reducing sugars	+	+	−	+	+	+	+	−	+	−	−	+	−	+	−
b. Sucrose	+	−	−	+	+	−	−	−	−	−	−	−	−	−	−
4. Gelatin:															
a. Tannic acid test	+	+	−	+	+	+	−	+	−	+	−	−	−	−	+
b. Biuret test	+	+	+	+	+	+	−	+	+	+	+	+	−	−	+
5. Chlorides	+	+	−	+	+	+	−	+	+	+	+	+	+	+	+
6. Sulfates	−	−	+	−	−	+	−	+	+	+	+	+	+	+	+
7. Calcium	−	−	−	−	−	−	−	+	+	+	+	+	+	+	+
8. Magnesium	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
9. Zinc	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−

TABLE 4.—Thickness in Inches
Before and after laundering

	Number of launderings		
	0	1	15
A	0.0058	0.0064	0.0069
B	0.0058	0.0062	0.0065
C	0.0051	0.0060	0.0066
D	0.0049	0.0062	0.0064
E	0.0063	0.0066	0.0067
F	0.0059	0.0066	0.0070
G	0.0065	0.0081	0.0082
Average pure dye silks	0.0058	0.0066	0.0069
H	0.0072	0.0084	0.0090
I	0.0056	0.0063	0.0069
J	0.0058	0.0065	0.0069
K	0.0056	0.0062	0.0071
L	0.0058	0.0063	0.0070
O	0.0072	0.0083	0.0089
Average weighted silks	0.0062	0.0070	0.0076
M	0.0053	0.0055	0.0063
N	0.0053	0.0072	0.0074
Average wild silks	0.0053	0.0063	0.0068

As shown in Table 5, the weighted silks shrank more than the pure dye, cultivated silks. More shrinkage was found in the warp direction of the pure dye, cultivated and wild silks than in the filling direction. The weighted silk shrank more in the filling than in the warp direction. The greatest shrinkage was observed in the weighted silks after 15 treatments. The average of warp and filling shrinkage for all of the silks was greatest after five treatments.

TABLE 5.—Percentage Linear Shrinkage (—) or Increase (+) of Silks After Treatments

	First treatment		Fifth treatment		Tenth treatment		Fifteenth treatment	
	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling
A	−2.6	+1.6	−2.6	−0.8	−1.8	0.0	−2.6	+1.6
B	−1.9	−1.2	−2.4	−1.9	−1.8	−1.2	−1.8	−1.5
C	−3.2	+0.8	−4.2	+0.4	−3.2	+0.8	−4.0	0.0
D	+0.3	+2.4	+0.8	+3.1	+1.3	+2.7	+0.5	+3.5
E	−1.1	−0.8	−1.1	−1.5	−3.1	−0.4	−2.6	+1.5
F	−1.3	+0.8	−0.8	+1.6	−0.5	+2.0	−0.8	−2.0
G	−4.5	−1.2	−4.3	−1.2	−4.5	−2.7	−3.5	0.0
Av. pure dye silks	−2.2	+0.3	−2.1	−0.04	−1.9	−0.14	−1.6	−0.4
H	−2.6	−3.5	−4.5	−3.9	−3.9	−3.9	−2.9	−5.8
I	−3.7	−5.1	−5.8	−6.3	−4.2	−4.7	−4.5	−5.1
J	−3.2	−6.7	−5.0	−9.1	−3.4	−7.5	−3.2	−9.1
K	−1.9	−3.5	−4.0	−5.1	−2.4	−3.5	−2.7	−4.7
L	−1.1	−4.3	−3.2	−5.9	−1.6	−1.3	−1.8	−3.2
O	−3.2	+0.8	−1.8	+1.2	−3.2	+2.0	−1.3	+2.0
Av. weighted silks	−2.8	−3.7	−4.0	−4.7	−3.1	−3.1	−2.7	−4.9
M	−1.0	+0.4	−0.5	−0.4	0.0	−0.4	−0.5	−0.4
N	−5.8	+0.4	−8.8	−0.4	−7.7	+0.4	−7.3	−0.4
Av. wild silks	−3.4	+0.4	−4.6	−0.4	−3.8	0.0	−3.9	−0.4

Table 6 gives the average breaking and bursting strengths of the fabrics with the percentage deviation. All of the silks lost more in strength upon exposure to light than they lost in laundering. The dry strength of the pure dye and wild silks was greater than the wet strength. The weighted silks were stronger when wet than when dry. All of the silks showed greater deviation in breaking and bursting strengths after exposure to light than after laundering. The deviation in the filling direction of the weighted silks for both wet and dry breaking strength was greater than in the warp direction. Pure dye and wild silks showed similar deviations in warp and filling. The breaking strength deviations, in warp and filling, both wet and dry, were similar for all silks. Greater deviation was shown in dry bursting strength than in wet bursting strength for all fabrics. In all cases, the pure dye silks showed the least variation and the weighted silks the greatest.

TABLE 6.—The Average Breaking and Bursting Strengths, with Percentage Deviations from the Average

	A		B		C		D		E		F		G		H	
	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation
Wet																
Warp breaking strength:																
New	112	10	97	5	140	3	102	5	114	4	114	7	135	4	102	11
Laundered once	115	3	91	4	130	4	102	6	112	4	117	3	85	8	65	10
Laundered 15 times	88	5	87	4	110	6	81	4	60	6	55	10	84	2	72	6
Exposed to light 6 hr.	70	9	62	7	92	5	65	7	78	5	78	6	95	13	60	25
Exposed to light 12 hr.	93	3	61	3	90	5	52	5	69	8	69	6	64	8	56	17
Exposed to light 24 hr.	59	7	59	7	73	12	42	5	53	16	64	9	69	18	49	14
Exposed to light 48 hr.	45	6	29	7	44	12	27	6	39	5	39	12	54	13	11	71
Filling breaking strength:																
New	60	3	79	3	77	2	77	5	75	4	68	3	72	5	61	2
Laundered once	52	9	60	6	58	4	62	5	68	6	65	3	58	4	37	7
Laundered 15 times	53	8	59	5	64	5	62	7	47	8	43	11	51	2	30	4
Exposed to light 6 hr.	38	10	60	6	52	7	54	5	60	5	58	6	43	9	36	9
Exposed to light 12 hr.	37	9	55	6	46	8	48	6	49	8	45	5	30	11	19	24
Exposed to light 24 hr.	23	10	41	10	44	6	35	7	41	8	49	6	23	11	2	165
Exposed to light 48 hr.	15	9	24	12	26	15	20	16	28	10	25	3	13	84	0	0
Bursting strength:																
New	129	3	127	3	136	3	133	2	116	2	120	4	158	20	118	4
Laundered once	115	5	118	7	116	7	118	4	122	4	108	8	122	4	103	3
Laundered 15 times	108	6	105	5	102	3	103	4	100	5	115	7	114	3	95	4
Exposed to light 6 hr.	111	3	115	6	120	5	103	7	115	5	121	3	137	6	79	6
Exposed to light 12 hr.	107	4	135	2	120	2	108	6	100	10	124	9	105	13	69	20
Exposed to light 24 hr.	90	4	87	5	89	6	97	15	89	5	110	5	105	10	42	16
Exposed to light 48 hr.	87	15	7	10	96	3	39	5	.....	.....	102	15	86	11	35	28

TABLE 6.—The Average Breaking and Bursting Strengths, with Percentage Deviations from the Average—Continued

	I		J		K		L		O		M		N	
	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation
Wet														
Warp breaking strength:														
New	107	8	90	4	85	16	101	5	114	4	75	12	37	9
Laundered once	64	11	67	5	69	6	66	8	111	3	53	7	18	3
Laundered 15 times	69	2	60	7	54	9	68	13	89	4	36	4	23	13
Exposed to light 6 hr.	59	4	63	8	82	7	64	9	96	4	55	7	22	7
Exposed to light 12 hr.	47	11	58	7	47	13	52	7	78	8	60	11	15	22
Exposed to light 24 hr.	38	16	35	19	25	10	42	11	59	11	32	6	10	29
Exposed to light 48 hr.	19	29	24	42	2	133	36	37	45	19	37	13	9	8
Filling breaking strength:														
New	54	5	51	5	54	6	46	3	85	51	54	9	88	9
Laundered once	28	6	28	8	34	4	19	11	78	51	62	9	60	4
Laundered 15 times	25	3	11	38	19	14	24	14	61	6	69	16	48	11
Exposed to light 6 hr.	26	2	22	11	29	13	18	13	72	10	47	23	58	7
Exposed to light 12 hr.	4	110	19	23	18	35	8	18	61	6	35	36	53	11
Exposed to light 24 hr.	11	90	10	43	8	108	7	72	35	21	16	6	50	7
Exposed to light 48 hr.	0	0	4	105	4	33	0	0	30	26	16	34	44	10
Bursting strength:														
New	101	6	90	6	95	7	95	12	148	3	180	10	99	10
Laundered once	84	5	82	4	81	3	68	7	134	3	126	8	73	6
Laundered 15 times	68	8	68	5	76	3	65	8	134	5	98	15	68	1
Exposed to light 6 hr.	79	5	79	3	79	7	76	5	129	8	97	8	79	6
Exposed to light 12 hr.	42	13	71	5	66	7	55	11	114	5	126	11	82	6
Exposed to light 24 hr.	39	16	40	43	55	19	61	19	68	21	69	12	65	10
Exposed to light 48 hr.	20	37	32	11	9	39	20	47	57	29	46	22	49	10

TABLE 6.—The Average Breaking and Bursting Strengths, with Percentage Deviations from the Average—Continued

	A		B		C		D		E		F		G		H	
	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation
Dry																
Warp breaking strength:																
New	154	5	126	4	161	5	135	5	135	3	135	5	151	4	50	5
Laundered once	144	7	127	5	161	7	111	3	119	9	120	8	99	5	52	11
Laundered 15 times	127	15	109	5	140	2	116	3	80	9	78	6	92	9	62	10
Exposed to light 6 hr.	88	8	76	7	95	3	72	6	76	8	91	4	158	7	33	27
Exposed to light 12 hr.	93	5	74	4	99	4	71	10	82	3	82	4	136	4	36	25
Exposed to light 24 hr.	77	8	73	5	104	7	53	13	71	10	76	7	113	21	36	30
Exposed to light 48 hr.	66	5	63	4	75	7	37	26	60	4	40	5	114	16	0	.....
Filling breaking strength:																
New	85	4	99	4	95	1	74	51	83	2	74	9	79	4	24	10
Laundered once	76	5	79	5	79	8	81	8	84	4	76	5	80	6	27	9
Laundered 15 times	69	5	80	4	75	5	75	1	59	4	52	10	62	6	32	10
Exposed to light 6 hr.	57	6	67	6	58	11	56	6	60	1	62	5	68	2	20	5
Exposed to light 12 hr.	58	4	67	6	66	5	51	4	60	7	53	4	66	8	2	70
Exposed to light 24 hr.	52	5	58	6	65	6	38	13	42	10	58	10	50	2	0	0
Exposed to light 48 hr.	38	15	45	7	47	8	25	13	32	8	36	13	31	17	0	0
Bursting strength:																
New	150	13	146	3	157	9	160	4	132	6	142	12	210	11	59	8
Laundered once	148	5	155	5	154	10	159	10	169	8	161	8	179	6	82	8
Laundered 15 times	132	8	116	9	128	11	134	9	128	8	125	9	129	25	87	15
Exposed to light 6 hr.	151	12	156	5	143	13	143	6	128	5	139	15	195	9	58	16
Exposed to light 12 hr.	159	6	140	6	157	3	140	6	121	9	128	10	162	15	31	27
Exposed to light 24 hr.	139	6	105	2	130	8	107	23	111	21	88	11	169	18	27	25
Exposed to light 48 hr.	101	12	81	13	132	8	68	51	.....	.....	103	3	171	8	16	18

TABLE 6.—The Average Breaking and Bursting Strengths, with Percentage Deviations from the Average—Concluded

	I		J		K		L		O		M		N	
	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation	Lb.	% Deviation
Dry														
Warp breaking strength:														
New	92	6	47	8	86	9	55	7	106	6	70	8	47	3
Laundered once	73	7	46	7	65	7	51	7	90	3	87	5	51	13
Laundered 15 times	59	11	48	7	67	4	57	14	97	6	67	13	35	12
Exposed to light 6 hr.	72	10	50	2	32	4	64	13	100	5	81	6	52	11
Exposed to light 12 hr.	51	13	47	6	61	30	37	18	79	5	71	10	48	1
Exposed to light 24 hr.	39	56	25	20	26	6	28	12	55	11	52	8	39	10
Exposed to light 48 hr.	30	23	23	21	18	53	45	13	37	15	42	15	36	20
Filling breaking strength:														
New	29	14	20	6	24	7	11	32	69	6	96	17	121	8
Laundered once	25	12	20	14	33	10	20	10	57	10	98	6	88	10
Laundered 15 times	35	9	23	11	32	14	30	5	68	5	117	8	78	10
Exposed to light 6 hr.	22	1	2	9	37	9	16	15	63	11	61	15	82	16
Exposed to light 12 hr.	8	108	3	110	31	13	10	46	55	3	70	34	76	8
Exposed to light 24 hr.	6	109	0	0	22	9	0	100	32	28	32	12	99	10
Exposed to light 48 hr.	0	0	1	125	2	165	0	0	26	26	37	26	71	7
Bursting strength:														
New	46	8	34	13	49	20	30	26	91	8	118	16	90	7
Laundered once	82	10	71	15	78	13	71	24	235	3	216	7	151	10
Laundered 15 times	71	16	76	10	76	13	72	11	106	6	139	19	117	12
Exposed to light 6 hr.	45	13	41	24	42	15	23	34	81	11	118	7	87	17
Exposed to light 12 hr.	26	39	38	11	30	61	27	24	75	14	151	15	104	21
Exposed to light 24 hr.	25	17	33	36	28	41	26	35	52	42	69	43	86	18
Exposed to light 48 hr.	11	46	17	29	7	38	6	87	32	42	51	18	55	25

Table 7 and Graphs I to IV show the percentage change in wet and dry breaking and bursting strengths after laundering and exposure to light. There was a greater decrease in the wet and dry breaking and bursting strengths of the weighted silks after exposure to light than of either the pure dye or wild silks. There was great similarity in wet and dry breaking strength of the pure dye silks; whereas there was a very decided difference in wet and dry strength of the weighted silks.

Weighted silks showed an increase in strength after laundering, probably due to shrinkage; whereas the pure dye silks increased in strength after one laundering but showed a decrease after 15 launderings.

In Table 8 the color of the new silks and the color of the silks after laundering and exposure to light have been classified according to the charts given in the *Dictionary of Color* by Maerz and Paul (5).

Table 9 gives the comparative fading.

A comparison of the degrees of fading in the various colors of each silk is given in Table 9. There was less fading due to exposure to light than due to laundering, except in the case of violet and blue. The fading of weighted silks was quite similar to the fading of pure dye silks. G, the highest priced silk tested, showed less fading than any of the other silks. Yellow faded less than any of the other colors; blue and violet faded most. The loss of blue in green and blue in violet was quite general. Pink faded more than peach and was more affected by laundering than the other colors.

TABLE 7.—Strength of Fabrics after Laundering and Exposure to Light

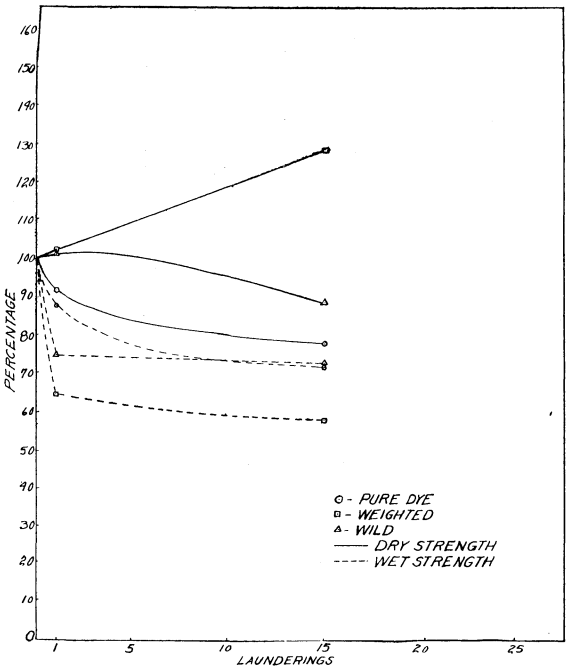
Expressed in percentage of strength of new fabrics

	Breaking strength															
	Launderings								Exposure to light							
	1				15				6 hours				12 hours			
	Warp		Filling		Warp		Filling		Warp		Filling		Warp		Filling	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
A	103	94	87	88	79	82	88	81	63	57	64	67	83	60	61	68
B	94	101	76	79	90	87	75	80	64	60	75	68	63	59	69	67
C	93	100	75	83	79	87	83	80	66	59	68	62	64	61	60	70
D	100	82	81	110	79	86	82	102	64	53	70	75	51	53	63	69
E	92	88	90	101	53	59	63	72	68	56	79	73	60	61	65	72
F	103	89	97	103	48	58	64	71	69	67	86	84	61	61	67	71
G	63	66	81	102	62	61	71	79	70	105	59	86	47	90	41	84
H	63	104	61	117	71	124	49	136	59	66	59	86	55	72	31	9
I	60	79	51	85	64	64	45	119	55	78	49	73	45	55	7	26
J	78	98	56	100	67	102	21	112	70	106	43	10	64	100	38	15
K	81	76	63	138	64	78	35	136	96	37	53	156	55	71	34	131
L	65	93	42	179	67	104	52	268	64	116	38	139	51	67	18	86
O	96	85	91	83	78	92	71	99	84	94	84	92	68	75	71	80
M	71	124	114	102	48	96	129	121	73	116	87	63	80	101	66	72
N	49	109	68	73	62	74	54	65	60	111	66	68	39	102	61	63

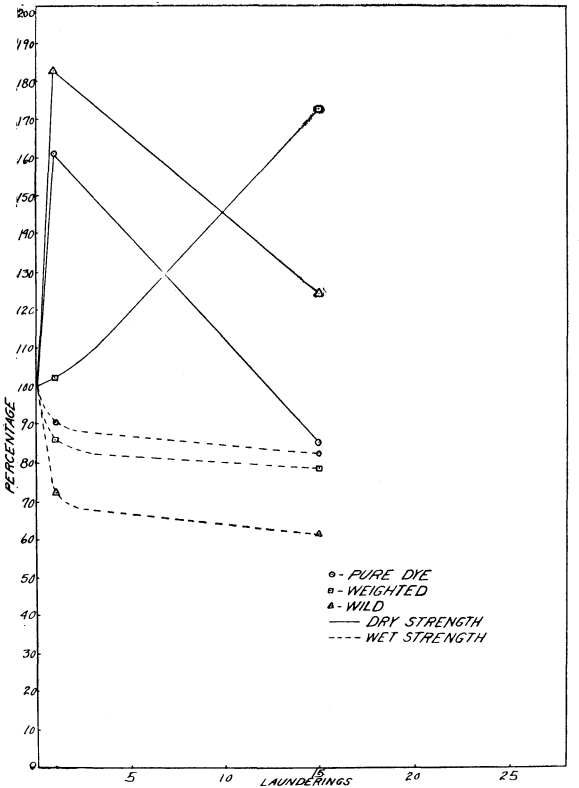
TABLE 7.—Strength of Fabrics after Laundering and Exposure to Light—Continued

Expressed in percentage of strength of new fabrics

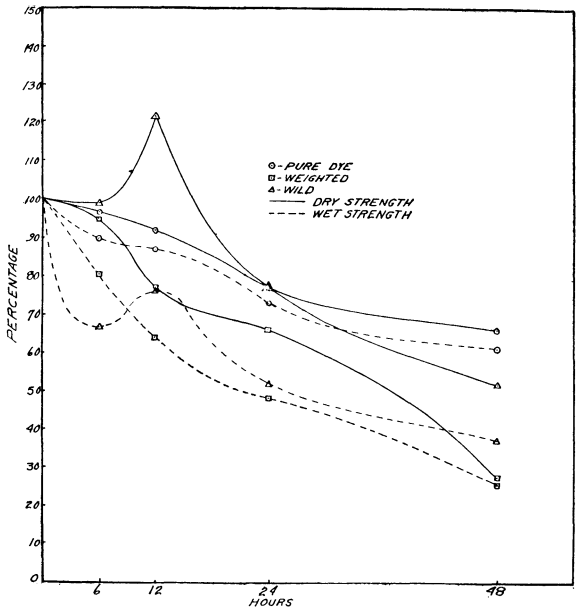
	Breaking strength								Bursting strength											
	Exposure to light								Launderings				Exposure to light							
	24 hours				48 hours				1		15		6 hours		12 hours		24 hours		48 hours	
	Warp		Filling		Warp		Filling		Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry												
A	53	50	39	61	39	43	25	45	89	148	84	88	86	101	83	106	70	93	67	67
B	61	51	52	59	29	50	30	45	93	155	83	79	91	107	106	96	69	72	59	55
C	52	65	57	68	32	47	34	49	85	154	75	82	88	91	88	100	64	83	71	84
D	41	39	45	51	27	27	26	33	89	159	77	84	77	89	81	88	73	67	29	43
E	46	53	55	51	34	44	37	39	105	169	86	97	99	97	86	92	77	84	.....	.....
F	56	56	73	79	34	30	37	49	90	161	96	88	101	98	103	90	92	62	85	73
G	51	75	32	63	39	75	19	40	77	179	72	61	87	93	66	77	66	80	54	81
H	48	72	3	0	11	0	0	0	87	82	81	147	67	98	58	53	36	46	30	27
I	35	42	20	22	18	33	0	0	83	82	67	154	78	98	42	57	39	54	20	24
J	39	53	19	0	27	49	8	4	91	71	76	224	88	121	79	118	44	97	36	50
K	29	30	15	91	2	21	8	7	85	78	80	155	83	86	69	61	58	57	9	14
L	42	51	15	4	36	82	0	0	72	71	68	240	80	77	58	90	64	87	21	20
O	52	52	41	46	39	35	36	38	91	235	91	116	87	89	77	82	46	57	39	35
M	42	74	30	33	49	60	30	39	70	216	54	118	54	100	70	128	38	58	26	43
N	28	83	57	82	51	77	51	59	74	151	69	130	80	97	83	116	66	96	49	61



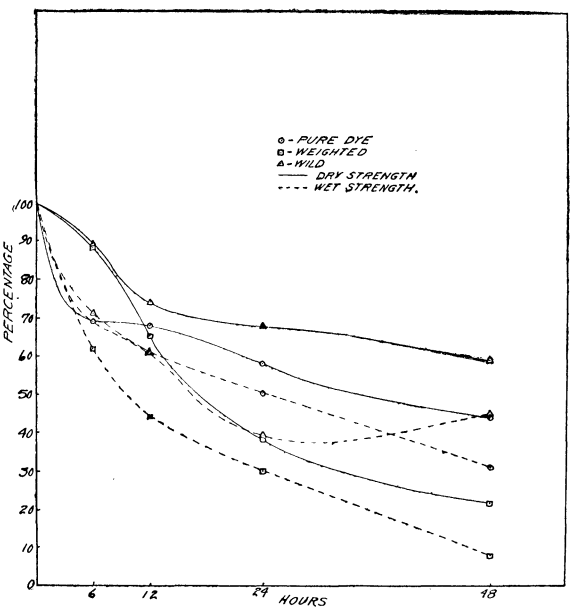
Graph I.—Average breaking strength—Laundering



Graph II.—Average bursting strength—Laundering



Graph III.—Average breaking strength—Light



Graph IV.—Average bursting strength—Light

TABLE 8.—Color of New Silks and of the Same Silks After Laundering and After Exposure to Light

(Colors classified according to Maerz and Paul, *Dictionary of Color*)

Silk	New			Number of launderings												Hours of exposure to light											
				1			5			10			15			6			12			24			48		
	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.
I. Green																											
A	17	B	9	17	C	7	17	E	7	17	E	6	17	D	5	17	B	8	17	B	7	17	B	6	17	E	5
B	28	I	11	27	G	11	27	G	11	27	F	10	27	F	9	28	H	11	28	H	11	28	F	10	28	D	8
C	20	A	10	28	A	11	28	A	10	28	A	9	28	A	8	20	A	10	20	C	8	20	F	8	20	G	5
D	17	J	7	17	J	7	17	I	6	17	G	6	17	G	6	19	G	5	19	F	4	19	B	3	19	E	2
E	25	D	11	25	E	10	25	E	9	25	B	9	25	B	8	25	D	10	25	D	9	25	C	9	25	A	7
F	26	J	10	26	H	10	26	F	10	26	B	10	26	A	10	26	H	10	26	E	9	26	I	9	26	B	8
G	29	K	5	29	J	3	29	J	2	29	J	1	29	I	1	29	J	5	29	I	4	29	D	....	29	H	3
H	29	F	8	28	F	6	28	D	6	28	A	5	28	A	4	29	F	7	29	E	7	29	A	6	29	B	6
I	28	H	12	28	G	12	28	C	10	28	D	8	28	B	7	28	F	11	28	D	10	28	A	8	28	A	5
J	26	F	7	26	C	7	26	B	6	26	A	3	26	A	3	26	E	6	26	C	6	26	A	6	26	A	4
K	27	G	12	18	F	12	18	E	11	18	G	8	18	E	8	27	E	12	27	C	12	27	A	12	27	E	11
L	30	J	9	29	G	8	29	F	8	29	A	6	29	A	6	30	J	8	30	I	8	30	I	7	30	D	8
O	19	B	10	17	B	8	17	B	6	17	B	4	17	A	3	19	B	9	19	B	8	19	B	7	18	A	6
M	26	E	8	26	B	7	26	A	6	26	A	5	26	A	4	26	C	7	26	A	7	26	B	6	26	B	4
N	20	B	7	20	B	6	20	A	6	20	A	5	20	A	4	20	B	6	20	B	6	20	B	5	20	B	4
II. Violet																											
A	52	A	9	52	B	8	52	A	8	52	B	7	52	B	7	52	A	9	52	A	8	52	A	8	52	A	7
B	52	B	6	52	B	6	52	B	5	52	A	6	52	A	6	52	B	6	52	B	6	52	A	6	52	B	5
C	44	D	4	43	C	4	43	C	4	43	C	4	43	C	4	44	D	4	44	D	3	44	B	2	44	E	1
D	52	F	8	51	D	8	51	C	8	51	D	7	51	C	7	52	E	7	52	D	7	52	C	7	52	G	6
E	41	J	8	41	I	8	41	G	7	41	E	6	41	D	6	41	I	6	41	H	6	41	D	5	41	D	5
F	42	H	7	41	G	7	41	E	6	41	E	5	41	D	5	42	G	6	42	F	5	42	F	4	42	F	4
G	43	I	2	43	H	2	43	H	2	43	G	2	43	F	3	43	G	2	43	H	2	43	E	2	43	E	3
H	42	J	9	42	H	7	42	F	7	42	C	7	42	B	6	42	H	7	42	H	7	42	F	5	42	F	3
I	43	J	8	43	H	7	43	H	7	43	B	5	43	B	5	43	H	6	43	G	5	43	F	4	43	E	3
J	42	J	6	42	H	5	42	H	5	42	G	4	42	F	4	42	G	6	42	F	5	42	E	4	42	D	3
K	42	G	6	42	F	5	42	D	5	42	B	4	42	B	3	42	G	5	42	E	5	42	D	4	42	C	3
L	41	F	4	41	E	4	41	E	4	41	C	3	41	C	3	41	E	4	41	J	4	41	C	3	41	G	2
O	44	K	6	44	J	5	44	I	4	44	G	3	44	G	2	44	J	5	44	B	4	44	B	3	44	B	1
M	52	C	5	51	B	5	51	B	4	51	B	1	51	B	1	52	B	5	52	D	4	50	C	3	52	B	1
N	49	D	4	49	C	3	49	C	1	49	B	2	49	A	2	49	D	3	49	D	2	49	C	1	49	B	1

TABLE 8.—Color of New Silks and of the Same Silks After Laundering and After Exposure to Light—Continued

(Colors classified according to Maerz and Paul, *Dictionary of Color*)

Silk	New			Number of launderings												Hours of exposure to light											
				1			5			10			15			6			12			24			48		
	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.
III. Blue																											
A	33	E	8	34	E	7	34	C	6	33	D	5	33	D	4	34	D	7	34	B	6	34	B	5	36	A	2
B	46	F	12	45	F	12	45	E	12	45	F	11	45	F	11	46	H	12	46	I	12	46	J	12	46	I	11
C	34	I	6	34	I	5	34	N	5	34	H	4	34	G	5	34	H	4	34	F	4	34	G	3	34	E	1
D	34	H	6	34	F	4	34	D	4	34	D	3	34	B	3	34	E	3	34	C	3	35	B	2	35	A	2
E	36	A	12	35	A	12	35	A	11	35	C	10	35	D	10	36	A	11	36	B	10	36	B	9	36	C	8
F	44	A	12	43	A	12	43	A	11	43	A	10	43	A	9	44	C	12	44	D	11	44	A	10	44	B	9
G	34	E	6	34	E	6	34	D	6	34	D	5	34	C	4	34	D	6	34	D	5	34	C	5	34	B	5
H	45	F	12	44	E	12	44	D	11	44	B	11	44	A	10	45	F	12	45	F	11	45	D	10	45	B	10
I	44	B	12	36	D	12	36	C	11	36	H	9	36	F	9	44	A	11	44	A	10	44	A	8	44	A	6
J	45	E	12	43	F	12	43	D	11	43	B	10	43	A	9	45	E	12	45	C	11	45	A	10	45	A	10
K	43	G	12	42	G	12	42	A	11	33	J	8	33	I	7	43	A	12	43	J	12	43	J	11	43	J	10
L	42	A	7	42	A	6	42	A	5	42	A	3	42	A	2	42	A	6	42	A	6	42	A	6	42	A	4
O	35	F	10	34	A	9	34	F	7	34	E	7	34	E	6	35	H	7	35	H	6	35	G	5	35	H	4
M	35	J	8	33	I	7	33	I	6	33	E	6	33	I	5	35	J	7	35	I	6	35	H	4	35	F	3
N	42	B	11	42	A	9	42	A	8	42	A	7	42	A	6	42	B	9	42	B	8	42	B	5	42	B	3
IV. Peach																											
A	10	A	6	10	B	7	10	B	7	10	B	6	10	B	6	10	A	6	10	A	6	10	A	5	10	A	5
B	10	A	7	10	A	6	10	B	5	10	C	4	10	C	3	10	A	6	10	A	6	10	B	5	10	B	5
C	10	C	8	2	B	8	2	A	8	2	A	8	2	A	8	10	C	8	10	C	7	10	C	7	10	D	7
D	11	B	7	11	A	6	11	A	6	11	A	6	11	A	6	11	B	7	11	B	7	11	B	7	11	B	6
E	11	A	6	11	A	6	11	A	6	11	A	5	11	A	5	11	A	6	11	A	6	11	A	5	11	A	4
F	11	H	9	11	H	9	11	G	8	11	G	8	11	G	7	11	H	9	11	H	9	11	H	9	11	E	8
G	4	I	11	4	I	11	4	I	11	4	I	11	4	H	11	4	I	11	4	H	11	4	H	11	4	G	11
H	10	A	7	10	A	7	10	B	6	10	D	3	10	D	2	10	A	7	10	B	7	10	B	7	10	B	6
I	11	A	7	11	A	5	11	A	5	11	A	4	11	A	4	11	A	7	11	A	7	11	A	6	11	A	5
J	10	A	6	10	A	5	10	C	3	10	A	1	10	A	1	10	A	6	10	A	5	10	A	5	10	D	5
K	10	A	5	10	A	5	10	A	4	10	A	3	10	A	3	10	A	5	10	A	4	10	A	4	10	A	4
L	3	L	6	3	L	6	3	L	6	3	L	3	3	L	3	3	L	6	3	L	6	3	L	6	3	L	6
O	9	D	7	9	B	7	9	A	6	9	A	5	9	A	3	9	D	7	9	D	7	9	D	6	9	D	5
M	10	D	8	10	D	7	10	D	6	10	C	5	10	C	4	10	D	8	10	D	8	10	D	8	10	D	7
N	9	F	9	9	F	8	9	E	7	9	E	6	9	E	6	9	F	9	9	F	9	8	F	8	9	E	7

TABLE 8.—Color of New Silks and of the Same Silks After Laundering and After Exposure to Light—Concluded

(Colors classified according to Maerz and Paul, *Dictionary of Color*)

Silk	New			Number of launderings												Hours of exposure to light											
				1			5			10			15			6			12			24			48		
	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.	Plate	Letter	No.
V. Pink																											
A	1	B	2	1	D	8	1	B	8	1	B	8	1	A	8	1	D	1	1	C	1	1	B	1	1	B	1
B	1	D	1	1	B	8	1	A	8	1	A	8	1	B	7	1	D	1	1	D	1	1	C	1	1	C	1
C	1	B	2	1	E	7	1	D	7	1	B	7	1	B	2	1	B	2	1	B	2	1	A	3	1	A	2
D	1	E	7	1	B	2	1	C	1	1	B	1	1	B	1	1	E	7	1	D	7	1	C	7	1	B	7
E	1	F	7	1	D	7	1	A	8	1	A	8	1	A	8	1	D	8	1	C	8	1	B	8	1	B	8
F	1	E	7	1	D	7	1	C	7	1	A	8	1	A	8	1	E	8	1	B	8	1	D	8	1	A	8
G	1	F	8	1	G	7	1	F	7	1	E	7	1	A	7	1	E	7	1	E	9	1	B	9	1	C	9
H	1	E	7	1	C	7	1	C	7	1	B	7	1	A	8	1	E	7	1	C	7	1	B	8	1	A	8
I	1	E	7	1	D	7	1	B	7	1	A	7	1	A	7	1	D	7	1	F	7	1	A	8	1	A	8
J	1	G	7	1	F	7	1	E	7	1	C	7	1	C	7	1	F	7	1	B	7	1	E	8	1	A	8
K	2	E	7	1	C	7	1	B	7	1	A	7	1	A	7	2	C	7	2	E	8	1	A	8	1	B	9
L	1	F	7	1	F	7	1	D	7	1	B	7	1	A	7	1	E	7	1	A	7	1	C	7	1	A	8
O	2	E	7	2	C	7	1	A	8	1	A	8	2	A	8	2	C	7	1	B	7	2	A	8	2	A	8
M	1	E	8	2	B	8	2	A	8	2	A	8	2	A	8	1	E	8	2	F	8	1	A	8	1	E	8
N	2	H	7	2	E	8	2	E	8	2	B	8	2	B	8	2	F	8	2	F	8	2	E	8	2	E	8
VI. Yellow																											
A	10	K	2	10	L	3	10	L	3	10	L	3	10	K	3	10	K	2	10	K	2	10	J	2	10	I	3
B	10	G	3	10	G	3	10	G	3	10	G	3	10	G	3	10	G	3	10	G	3	10	G	3	10	E	3
C	3	L	6	3	L	5	3	K	9	3	K	8	3	J	8	3	L	6	3	L	5	3	L	4	3	L	3
D	11	L	4	11	L	5	11	K	4	11	K	4	11	J	3	11	L	4	11	K	4	11	K	4	11	K	4
E	10	J	5	9	I	5	9	I	5	9	G	4	9	G	2	10	J	5	10	J	5	10	J	5	10	I	5
F	9	J	3	9	I	3	9	I	3	9	I	3	9	I	3	9	J	3	9	I	3	9	G	3	9	G	3
G	9	J	3	9	I	3	9	I	3	9	H	3	9	H	3	9	J	3	9	J	3	9	I	3	9	H	3
H	10	J	7	10	I	6	10	I	6	10	G	5	10	F	5	10	J	7	10	J	7	10	J	6	10	J	6
I	10	J	2	10	I	2	10	I	2	10	D	1	10	C	1	10	J	2	10	J	2	10	J	2	10	I	2
J	10	K	5	10	K	5	10	K	5	10	J	3	10	I	3	10	K	5	10	K	5	10	K	5	10	K	5
K	10	H	4	10	H	3	10	E	2	10	C	2	10	B	2	10	H	4	10	H	4	10	H	4	10	H	4
L	10	J	2	10	J	2	10	I	2	10	F	2	10	F	2	10	J	2	10	J	2	10	J	4	10	J	2
O	10	J	3	10	I	2	10	F	2	10	D	1	10	C	1	10	J	3	10	J	3	10	J	3	10	I	3
M	10	F	4	10	E	3	10	D	3	10	C	3	10	C	2	10	F	4	10	F	4	10	F	4	10	F	4
N	2	I	12	2	G	12	2	E	12	2	F	12	2	E	11	2	I	12	2	I	12	2	H	12	2	G	12

TABLE 9.—Comparison of Fading of Silks

By light

	Violet				Pink				Peach				Yellow				Green				Blue			
	Hours of exposure				Hours of exposure				Hours of exposure				Hours of exposure				Hours of exposure				Hours of exposure			
	6	12	24	48	6	12	24	48	6	12	24	48	6	12	24	48	6	12	24	48	6	12	24	48
A	0	0	1	1	1	1	2	3	0	1	2	3	0	0	1	2	0	1	2	4	1	1	2	3
B	0	1	1	2	0	1	2	3	1	1	2	3	0	0	0	1	0	1	1	2	0	1	2	3
C	0	1	2	4	0	1	1	2	0	1	1	2	*	*	*	*	0	2	2	5	2	3	4	5
D	0	0	1	1	1	2	2	3	0	1	2	3	0	0	1	2	1	2	2	3	2	3	4	5
E	2	3	4	5	1	2	3	4	0	1	1	2	0	0	0	1	1	2	3	4	1	2	4	5
F	2	3	4	5	1	2	3	4	0	0	1	2	0	0	1	1	1	2	3	4	1	2	3	4
G	0	1	2	3	1	1	2	3	1	1	2	3	0	0	0	1	1	2	2	3	0	1	1	2
H	1	2	4	5	0	1	2	3	1	1	2	3	0	0	1	2	0	1	2	3	0	1	2	3
I	2	3	4	5	0	1	2	4	0	1	1	2	0	0	1	2	0	1	2	3	1	2	4	5
J	1	2	3	5	0	1	2	3	1	1	2	3	0	0	0	1	1	2	3	5	1	2	3	4
K	2	3	4	5	0	1	2	3	0	0	0	1	0	0	0	1	1	1	2	3	1	2	3	3
L	1	2	3	4	0	1	1	2	*	*	*	*	0	0	0	1	0	1	2	4	1	2	3	5
O	2	3	4	5	1	2	2	3	0	0	1	2	0	1	1	1	1	1	2	3	1	2	4	5
M	1	2	3	4	0	1	1	2	0	0	0	2	0	0	1	2	0	1	1	3	1	2	3	4
N	1	2	4	5	0	0	1	1	0	0	1	2	*	*	*	*	1	1	2	3	1	2	3	4

0.—No fading.
1.—Slight fading.
2.—Fading greater than (1) but less than (3).
3.—Fading greater than (2) but less than (4).
4.—Fading greater than (3) but less than (5).
5.—Color almost gone.
6.—Color gone.
* —Not comparable.

TABLE 9.—Comparison of Fading of Silks—Continued

By laundering

	Violet				Pink				Peach				Yellow				Green				Blue			
	Launderings				Launderings				Launderings				Launderings				Launderings				Launderings			
	1	5	10	15	1	5	10	15	1	5	10	15	1	5	10	15	1	5	10	15	1	5	10	15
A	1	1	1	2	0	1	2	4	0	0	1	1	0	1	1	2	1	1	2	4	1	1	2	3
B	0	0	1	2	1	2	3	4	1	2	3	4	0	0	0	0	1	2	2	3	1	1	2	2
C	0	0	1	1	0	1	3	4	2	3	4	5	*	*	*	*	1	2	2	3	1	2	2	3
D	0	1	1	2	1	2	3	4	1	1	1	1	0	1	1	2	1	1	1	2	1	2	2	3
E	1	2	3	4	2	3	4	6	1	2	3	4	0	1	2	4	1	2	3	4	1	2	3	4
F	1	2	3	4	1	2	3	4	0	1	2	3	0	0	1	1	1	2	3	4	1	2	3	4
G	1	1	2	2	0	0	1	1	0	1	2	3	1	1	2	3	1	1	1	2	1	1	1	2
H	1	2	3	4	1	2	4	6	1	2	4	5	0	1	2	3	1	1	2	3	1	2	3	4
I	1	2	3	3	1	2	3	6	1	1	2	2	0	1	3	4	1	2	3	4	1	1	2	3
J	1	1	2	2	1	2	3	3	1	3	4	5	0	1	2	3	1	2	4	5	1	2	4	5
K	1	2	3	4	1	3	4	6	1	1	2	2	1	2	3	4	1	2	4	5	1	3	4	5
L	1	1	3	3	0	2	3	6	*	*	*	*	1	1	3	4	1	2	4	5	1	2	4	5
O	1	2	3	4	1	3	4	6	1	1	2	4	1	1	2	3	1	2	3	4	1	1	2	3
M	1	2	3	3	2	3	4	6	1	2	3	3	1	2	2	2	1	2	3	3	1	1	2	3
N	1	2	3	4	1	2	3	4	1	1	2	2	*	*	*	*	0	1	2	2	1	1	2	3

0.—No fading.
1.—Slight fading.
2.—Fading greater than (1) but less than (3).
3.—Fading greater than (2) but less than (4).
4.—Fading greater than (3) but less than (5).
5.—Color almost gone.
6.—Color gone.
* —Not comparable

SUMMARY

A study of 15 washable silk fabrics was made in order to determine the effect of laundering and exposure to light upon the strength and color fastness of pure dye, weighted, and wild silks. For the physical and chemical analyses, white silks were used. Six colors (pink, peach, yellow, green, blue, and violet) in each type of silk were used for the fading tests.

The pure dye silks cost from $1.78 to $3.68, the weighted silks from $1.49 to $2.72 per square yard. The two wild silks cost, respectively, $1.12 and $1.14 per square yard. In this study, price was found to be highly correlated with quality, since the higher priced silks, both the pure dye and weighted, showed a higher bursting and breaking strength, were heavier, had greater thickness, and contained less weighting and water-soluble finishing material.

The weighted silks were stronger when wet than when dry but were not as strong as the pure dye silks, which had a greater dry than wet strength. A greater decrease in strength due to exposure to light than to laundering was observed for both pure dye and weighted silks. The pure dye silks showed less decrease in strength upon exposure to light than the weighted silks. The weighted silks showed an increase in strength after being laundered. This increase was probably due to shrinkage of the silks during the laundering process.

In the factors studied, the pure dye, branded silks showed no superiority over the unbranded pure dye silks. The one weighted silk which was branded was superior to the unbranded weighted silks in strength, weight, thickness, and amount of weighting.

There was a great similarity in the fading of the pure dye and weighted silks. For all, there was very slight fading after 12 hours of exposure to light and after five launderings. Fading increased with 24 and 48 hours of exposure to light and with 10 and 15 launderings. Violet and blue showed more fading due to exposure to light than as a result of laundering. The other colors faded more in laundering. Yellow faded the least and blue the most. Violet faded to a red violet and green to a yellow green, indicating the loss of blue. Pink was the only color which disappeared entirely in laundering. Upon exposure to light, all of the colors became somewhat grayed. Laundering caused, in every case, a decrease in the amount of color.

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